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SPRUCE BUDWORM

OPERATIONAL GUIDELINES

U.S. Department of Agriculture - Forest Service

Division of State and Private Forestry
Region 1

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SPRUCE BUDWORM
OPERATIONAL GUIDELINES

INTRODUCTION

The spruce budworm is a native insect of the fir and spruce forests of the Northern Region. In early years (1922-1944) epidemics have come and gone usually before tree mortality was of any consequence. In recent years the spruce budworm has become an important forest pest necessitating chemical control by aerial spraying.

In 1922 two widely separated outbreaks occurred at Priest Lake and at New Meadows, Idaho. These epidemics were of short duration and subsided naturally. In 1923 an infestation of short duration was discovered (on the Helena National Forest) near Townsend, Montana. Since 1923 several outbreaks have been reported, but usually have been controlled by natural causes before tree mortality became intolerable. However, a serious epidemic detected in 1942 on the South Fork of the Flathead River lasted 8 years and caused extensive tree mortality on over 200,000 acres before it subsided.

Since 1947 the spruce budworm has become aggressively epidemic on millions of acres along the Continental Divide in Montana. At present, over 3 million acres of fir forest stands are infested by the spruce budworm in varying degrees of severity. Aerial spraying for control has reduced many epidemics to endemic conditions and has been a factor in eliminating some infestations. In control areas where small areas were missed; or where there was a high biotic potential; or where operational and biological work was not timed properly, reinfestation has occurred. In general, however, completed control projects have been successful.

Since 1945 studies have been conducted to determine the effect of DDT (dichlorodiphenyltrichloroethane) on birds, fish and other wildlife. Early observations did not indicate any serious losses from the aerial spray projects. Thus, in Montana, no attempt was made to keep the insecticide out of streams within a spray area during the 1955 and 1956 aerial applications. In 1956 cooperative studies were programmed by the Montana State Fish and Game Department, U.S. Fish and Wildlife Service, and the U.S. Forest Service to determine the effects of DDT on fish and aquatic insects. These studies have shown that contour spraying by helicopter about one-eighth mile away from major streams, is essential in rough terrain. Also, that spraying in the upper reaches of main drainages is usually not necessary, thus these unsprayed areas can contribute aquatic insects for repopulation of streams within spray boundaries. To further minimize the effect of DDT aerial spraying, spray block boundaries are not located along streams and instructions are to spray near stream and lake shores only when the wind velocity is low or nonexistent.

DETECTION

Most forested land is covered by a cooperative insect detection program. This program is a cooperative undertaking between public and private landowners

and consists of two distinct phases. The most important phase is a regular field surveillance program carried on by regular forest workers in connection with regularly assigned duties. The second phase is planned systematic surveys (both aerial and ground checks) that supplement field surveillance.

1. Field Surveillance (FSM 5221)

The responsibility for field surveillance rests with the Forest. All forest workers are expected to be trained and alerted to report new spruce budworm infestations; abnormal buildups in endemic areas; and/or reductions in spruce budworm numbers in areas classified as epidemic.

In reporting new outbreaks the standard form 5200-1 will be used (FSM 5221). Care must be exercised in filling in this form so that all pertinent information for the spruce budworm has been included. If only immature forms of this insect are present, collect and place in 70-percent alcohol or rubbing alcohol 10 specimens of each stage present and send to Regional Forester, U.S. Forest Service, Division of State and Private Forestry, Missoula, Montana 59801. Moths collected for identification should be placed in a killing jar or killed by putting two or three drops of gasoline on the abdomen. The dead moths should then be placed between two layers of cotton, boxed, and sent to the above address. Care must be exercised in handling the moths so as to not remove the scales on the wings.

Insect detection schools are held on all National Forests at least every 3 years.

2. Aerial Detection Surveys

Aerial detection surveys for spruce budworm are made from light high-wing aircraft having not less than 225 horsepower. The surveys are most effective when made during the period July 25 to September 10--the period of maximum visibility of the foliar damage. Complete coverage of host type is planned on aerial detection surveys. In rough terrain, such as is found in most of Region 1, a contour pattern is flown. The height of the flight is usually about 800 feet above the ground. Two passes are usually made along the sides of the timbered hills; one near the base and another one higher up the slope. The small side drainages are observed by flying in and out of them on a contour system. All visible foliar damage is mapped on a 1:125,000 scale map. The damage to the stand is classified into four categories: light, moderate, heavy, and very heavy. The appearance of each category is: Light - defoliation is barely visible and appears to be confined to the upper one-fourth of the crown; the damage is not necessarily continuous through the stand and there may be a few heavier spots of defoliation. Moderate - defoliation is clearly visible and is apparent in the upper one-third to one-half of the crown; it may not be continuous through the host type and there may be some heavy spots of damage. Heavy - defoliation is visible on most trees to the bottom of the crown; it is nearly continuous and there may be top killing in spots. Very heavy - this category has all the elements of heavy plus evidence of recent tree mortality.

From the air the threshold of visible damage is approximately 25 percent defoliation in good light. The verbal descriptions of damage given when expressed in percent of defoliation are: light, 25 to 35 percent; moderate, 36 to 55 percent; heavy 56 to 85 percent.

There are a number of conditions of foliage that give it an appearance similar to spruce budworm damage. Some of these are caused by frost damage, hail damage, needle cast, spider mites, and heavy cone crops.

Approximately 100 flight hours of training are required to train an observer for aerial detection surveys.

3. Ground Crew Followup

Aerial detection should be checked from the ground occasionally to determine if the aerial observer is recording the correct information. It is preferable to have the aerial observer do some of the ground work.

BIOLOGICAL EVALUATION

Biological evaluations of spruce budworm often require a measure of the insect population. In the Northern Region, egg masses are used as the most practical measure of budworm population.

1. Egg masses from a series of 25 permanently established plots are used to determine the current status and the regionwide trend of the infestation.

Each plot consists of an intermediate Douglas-fir tree or trees in an even-canopied stand. The plots are distributed through the infested areas in Montana, to give a representative sample of the outbreak trend. Each plot tree is numbered to permit comparable samples to be taken annually from the same trees. Sometimes supplementary plots are used.

a. During early September foliage for egg mass counts is collected from the plot trees. A piece of canvas about 4 feet square is spread on the ground and enough limbs are cut from one side of the tree at mid-crown with pole pruners to roughly cover the canvas. All the foliated twigs are removed from the limbs and placed into an 18- by 30-inch plastic bag. The process is then repeated for the opposite side of the tree.

The samples are labeled by plot, tree number, and tree side. Soon after collection, all the samples are stored in a cold room maintained at about 38° F.

b. When all the samples have been collected, a crew of women laborers examine the foliage. (Women are much preferred over men for this work.) The foliage samples are spread on a table marked off in gridiron fashion with the area covered in even 100 square inches marked at each line. The foliage is evenly spread on the table starting from the end mark. The square inches covered by the foliage sample are then recorded to the nearest 100 square inches. Most samples contain from 1,500 to 2,000 square inches. The foliage is piled in the middle of a work table around which are seated the crew members. Each crew member removes a few twigs and clips them into 3- to 4-inch lengths. All needles with any foreign material are removed by crew members and placed in petri dishes. When all the foliage from the sample has been examined, the petri dishes are passed to an entomologist who separates the needles having egg masses from those with other matter on them.

Egg masses are difficult to see; therefore, the work room must be very well lighted. Overhead fluorescent lights supplemented by fluorescent desk lights for each individual are used.

The entomologist directs the crew, trains the workers, measures the samples, keeps all the records of the samples and makes periodic checks of examined foliage.

When all the foliage has been examined, the enotomologist separates the current year's egg masses from the old egg masses. This separation is the most difficult phase of the work. A binocular microscope set for 20 power is used. First a guide is made by selecting about 50 egg masses on new (current growth) needles. New needles may be identified because when they dry they shrink and have a dimpled, light green skin. Egg masses on these needles are positively classified as new. These samples are cemented to a card for handy reference. Egg masses showing more deterioration than those on the card are discarded as old.

Current egg masses are expressed as egg masses per 1,000 square inches. The trend of the infestation is obtained by comparing current egg masses per 1,000 square inches with the egg masses for the preceding year.

2. Egg masses from single tree plots are used to predict the defoliation in proposed control areas. They are used to determine the need for control and to measure the results where control is undertaken.

From 15 to 25 single tree samples are established at intervals throughout the proposed control area. These plots must be within the actual spray area. Selected trees are marked and mapped to enable subsequent samples to be taken after control measures have been applied. Foliage samples are collected from these trees and treated in the same manner as described for the permanent plots.

3. Egg Mass Surveys to Predict Defoliation

Egg masses per 1,000 square inches of foliage correlate reasonably well with subsequent defoliation. Expected defoliation can be estimated by comparing egg masses per 1,000 square inches with the predicted defoliation in the graph (fig. 1).

RESOURCE EVALUATION

Because Douglas-fir trees drop part of their old foliage each year, complete defoliation of the current needle growth each year will kill Douglas-fir trees in 3 to 7 years. Normal needle retention for Douglas-fir is 4 to 5 years. In this spruce budworm epidemic that has persisted for 17 years, (1947-1964) much of the reproduction and many of the suppressed poles and saplings have succumbed because of repeated defoliations. However, group mortality of the mature trees has been mostly confined to the poorer, drier sites. Previous investigations have shown that continuous defoliation is the primary cause of tree mortality because it inhibits the normal physiological functions. However, in some cases, bark beetles attack the weakened trees.

Increased tree mortality can be expected if the current epidemic continues at its present level of deolifation. To determine the amount of tree loss, mortality surveys were devised. These surveys in the Northern Region have been limited to line-plot samples taken across drainages on a predetermined grid. One-tenth-acre plots are established at 4-chain intervals on a selected bearing. Usually these lines are 80 chains in length, starting from a road or trail in the bottom of a drainage to the top of a ridge on each side of the drainage. The first plot is taken at a random distance

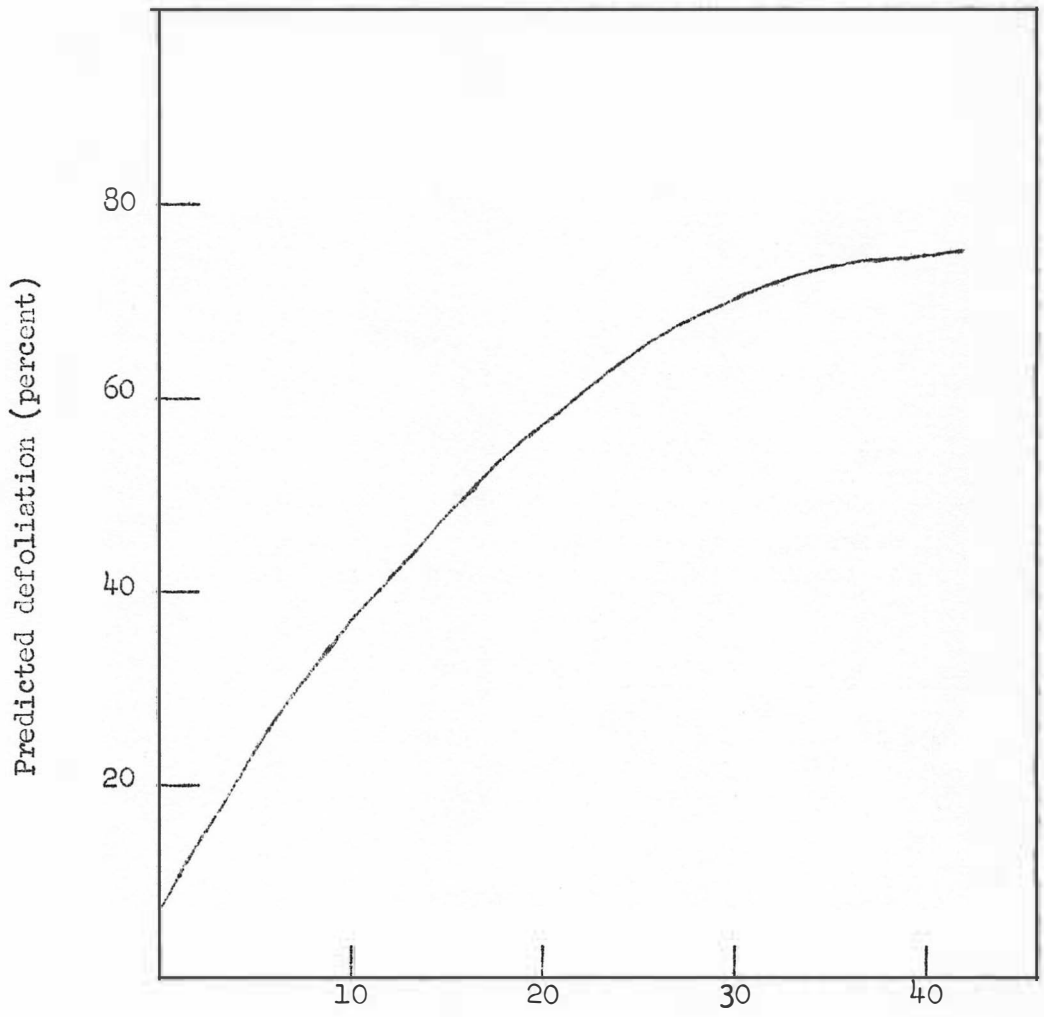


Figure 1.--Relationship of egg masses to defoliation

inside the type boundary, while plot number two is established at a distance of 4 chains from plot number one. All dead and green tree diameters and heights are classified and recorded on each 1/10-acre plot. (Only dead trees caused by repeated spruce budworm defoliation are tallied.) In addition, site and aspect, and pathological conditions are recorded.

The effect of spruce budworm defoliation on tree growth in the Northern Region has been limited to observations on tree deformation, top killing, and mortality.

Research is needed to determine the effect of defoliation on diameter growth. After the first year of spruce budworm attack in the northeast, the rate of growth of balsam fir trees is only about one-half that of the average for the preceding 10 years.

Increment cores from infested trees show small annual rings about 2 years after first attack. Foresters have estimated the Montana tree growth loss at over $35 million since 1948.

Because of extensive defoliation by the spruce budworm, many Christmas tree areas on four National Forests have been abandoned for Christmas tree harvest. Montana formerly produced over half the Nation's Douglas-fir Christmas trees annually. Since 1960 there has been a definite reduction in output and the quality of trees shipped has been lower from many areas in and near the Lewis and Clark, Helena, Bitterroot, and Deerlodge National Forests because of spruce budworm defoliation.

Economic values of a Douglas-fir stand also include esthetic, recreational, and watershed values. Much of the natural beauty of the fir-covered hills of Montana is threatened by the current budworm infestation. The many snag patches created by uncontrolled budworm are a serious forest fire hazard. Douglas-fir and spruce plantations cannot become established in infested areas without periodic budworm control action.

1. Decision on Control Action

A decision to control or not to control an outbreak in potentially commercial Douglas-fir stands depends upon biological and resource evaluations. These are as follows:

a. The current trend of the infestation indicates a continuance of equal or greater damage.

b. The current level of defoliation is high, averaging 50 percent or more, or that defoliation of the preceding year plus current damage exceeds 50 percent of foliage.

c. Host mortality is imminent. This is difficult to assess. Generally, it is a conclusion based upon opinion that accumulated damage plus continued loss of foliage in the next year or two will result in the death of a considerable number of trees.

d. Natural control is currently inadequate. Evidence of parasites, predators, diseases, and other factors operating to reduce spruce budworm populations appear inadequate. Absence of these controlling factors indicates a static or increasing trend of the budworm.

e. Other values may be damaged if aerial spraying is not properly planned and supervised. Full consideration is given to the effects of chemicals used in sprays on fish and fishfood organisms, birds, and game animals.

SUPPRESSION

1. Proposed Projects

Spruce budworm aerial spray projects are proposed by National Forest Supervisors by October 15. After biological and resource evaluations have been made by Division of State and Private Forestry personnel, the proposed projects are sent to the Division of Timber Management and the Regional Forester for review. On receiving concurrence by all concerned, the project proposals and request for funds to implement the program are sent to the Washington Office. These proposals require Washington Office and Federal Pest Control Review Board approval.

2. Zones of Infestation

After funds have been allocated for an aerial spray program, the Regional Office will obtain the necessary clearances from State Foresters and Forestry Boards for declarations of zones of infestation and other processing required under State laws.

After the zones of infestation have been established, the State Forester usually holds an informational meeting for landowners at some centrally located town within or near each of the proposed spray areas. Forest Service personnel present a biological evaluation of the outbreak and outline proposed control projects. The State Forester leads a discussion on cost-benefit ratio and possible side effects, plus cost-sharing agreements. Based on the approval of these landowners, the State Forester starts collecting the private landowners' cooperative share of the estimated cost.

3. Area Computations and Master Mosaics

All final area computations will be made on aerial mosaics or 2-inch planimetric maps, using the General Land Office plats for gross basic section acreage totals. Aerial photographs and timber type maps will be used to determine host type. All computations will be made on the basis of spray acreage within each individual section and these acreages recorded by section, township, and range. This work should be done accurately at the outset so that spray acreage data arrived at may serve for all future area computations, including spray block acreages, private owner payments, contract payments, etc. Thereafter, block acreages can be obtained from the initial acreage tabulation forms. Nonhost types of 160 acres or more will be deducted from area computations. Open areas, 20 chains or more in width, will be deducted from spray acreages, if parallel to spray swaths. Acreage recording forms (Exhibit 1) will be provided by the Regional Office. Following completion of the initial master mosaic, including the delineation of spray area boundaries, spray block boundaries, etc., the project supervisor concerned will have an additional copy made up as soon as possible for use by the biologist.

4. Control Unit Boundaries and Spray Blocks

Unit boundaries will be established by the Forest Supervisor and a member of the Regional Forester's staff. Aerial photos and mosaics will be used to

determine these boundaries based on survey data and topographic features recognizable from aircraft.

The Regional Office will handle the procurement and preparation of aerial photographs and mosaics for use in conjunction with spraying operations.

Spray area blocks will be the responsibility of the Forest. They will be established by using the following guidelines:

a. Basic layout of blocks to contour major drainages.

b. Spray blocks to be 3,000 to 4,000 acres in size.

c. Maximum variation in elevation within a block must not exceed 1,500 feet, but 1,000 feet should be used in basic planning.

d. Block boundaries will be along ridge tops or across slopes, large forest openings, or boundary of nonhost type. This prevents spray planes turning over and double spraying of major streams.

e. Conspicuous topographical features should be used as spray block boundaries where possible so as to aid spray pilots with their orientation.

Adequate air observational checks will be made before the final boundaries are established on the master mosaic.

5. Landowner Contacts

Every private forest landowner having more than 20 acres of potentially commercial host type within a spray unit must be solicited and asked to cooperate in the spray program. For the purpose of soliciting financial cooperation from private landowners, the best infestation and spray area data should be used. Only forested areas should be included in calculating spray area. Permission to spray private land within the unit boundary will be obtained even though financial cooperation is not possible.

The Regional Office (Division of State and Private Forestry) will provide all State and private land cooperative agreements and forms, and set up policy and procedure for private landowner solicitations. (Agreement No. 20-13 between Regional Forester, Forest Service, Region 1, and Montana State Forester dated November 26, 1963.) Should the State Forester request assistance in contacting small landowners, he will authorize (in writing) Forest Service personnel to sign agreements and make collections in behalf of the State Forester. Agreements will not be made until the specific control unit concerned has been declared a zone of infestation and otherwise cleared for control action.

A full explanation of the effects of chemical spray on bees, dairy herds, and fur farms will be covered when contacting private landowners.

The Regional Office will be responsible for contacting and obtaining the cooperation of the Northern Pacific Railway, Anaconda Forest Products Company, and similar large private landowners through the State Forester's office. National Park Service and Bureau of Land Management contacts will be the responsibility of the Regional Office.

Owners who are not readily accessible within or adjacent to the National Forest should be considered nonresident. Nonresidents will be solicited by

letter from the State Forester's office. To assist the State Forester in the preparation of these letters, please submit to the Division of State and Private Forestry, by March 1, the following information:

a. Name of landowner.

b. Present mailing address.

c. Legal description of ownership.

d. Acreage of forested spray area within the boundaries of this private land.

Doublecheck the above for accuracy.

It is desirable to make certain that all small-owner forest lands for which financial cooperation is sought are of the type which is immediately endangered or already infested by the current insect epidemic. Care should be exercised to exclude grasslands, marginal areas which are being converted to agriculture or rangeland, etc. We should endeavor to seek financial cooperation only on small-owner lands which are definitely forested and are likely to remain so in the future. On-the-ground examination may be necessary should the owner declare less forested land than the mosaic or aerial photos indicate. In computing the amount a cooperator should pay, as called for under item 2 of the agreement, a rate of 50 cents per forested spray acre should be used. This is 50 percent of the $1 per acre estimated cost of the spray job. Do not take token payments. Do not settle for less than 50 cents per forested acre. In making collections it should be emphasized that a refund will be made in the event the aerial spraying job is not carried out or the total costs are less than $1 per acre.

Cooperative agreement forms (Exhibit 2) should be made in quadruplicate. Indelible pencil or ballpoint pen should be used. The original and one carbon copy of each agreement, together with collections made, should be forwarded currently to the State Forester through the Forest Supervisor. The State Forester will, in turn, immediately forward the originals of all agreements to the Regional Office, Division of State and Private Forestry, where a separate accumulative record will be maintained for each control unit. If collection is not made at the execution of agreement, the cooperator should be instructed to forward his cooperative work fund deposit directly to the State Forester. One copy should be given to the cooperator. The last copy is retained by the Forest. A notation should be made on the margin of all copies of each agreement stating the amount of any collections made, and the notation should be signed by the State Forester's representative making the collection. This will serve as a receipt to the cooperator and a record of payments made for accounting purposes. Remittances collected should be drawn payable to the State Forester. State and Forest Service officers assisting in agreement negotiations are not authorized to accept cash.

Three alphabetical lists of private landowners will be prepared by the Forest and sent to the State Forester and Division of State and Private Forestry; one will be retained by the Forest. Each list will show:

a. Name of owner.

b. Acres by township, range and section.

c. Amount of money collected.

These lists will be due by June 15.

Periodically, and/or at the close of cooperative collection work, the Regional Office will bill the State Forester for the total amounts collected to date for the various control units. This billing will be made in accordance with the master agreement between the Regional Forester and the State Forester.

6. Cooperation with Interested State and Federal Agencies

It will be the responsibility of the Regional Office to keep other interested agencies informed of major pest control activities.

a. State Fish and Game Departments will be contacted and proposed control units will be reviewed. A field trip in August or early September, prior to the spray year, should be scheduled to show damage and tree mortality. The need for prespray aquatic insect data will be discussed at this time.

b. The Pesticide Laboratory of the U.S. Fish and Wildlife Service, Denver, Colorado, should be apprised of proposed control units by November 1 preceding the spray year. Maps should be sent with the writeup. Planned aquatic insect administrative studies will be reviewed with the Pesticide Laboratory.

c. State Health Departments will be informed of aerial spray projects, so any water pollution problems may be explored prior to bid solicitations. A special action plan should be prepared for town or municipal watersheds within spray boundaries.

7. Information and Education Aspects of Program

The Regional Office will be responsible for the development of guidelines and correlation of publicity at all levels. They will also endeavor to develop feature articles, photographs, radio scripts, and similar general purpose items for general dissemination. In addition, spot news items will be developed in outline form so that Forests can fill in local statistics and information to apply to each project.

The Forest will be responsible for handling all local information and education work which should emphasize the overall, long-range budworm problem. Show-me trips to heavily infested areas in August prior to the spray year should be arranged for key individuals. (Maximum discoloration due to budworm feeding is usually about August 10.)

ORGANIZATION AND PERSONNEL RECRUITMENT (FSM 5242)

Regional Office Responsibility

The Regional Office will be responsible for the assignment of a project director, assistant project director, contracting officer, formulation checker, and air officer for the entire spruce budworm project on several Forests. (Exhibit 3)

1. Project Director

The project director will coordinate the work between units, between cooperators, and between the several Government agencies concerned. Safety

and welfare of personnel are an integral part of the director's overall responsibilities.

2. Assistant Project Director

The assistant project director is primarily responsible to the project director for the administrative aspects of all technical training and entomological work connected with the program; conducts cooperative aquatic life studies; aids with State and private forest landowner cooperation; and contributes to Information and Education aspect of the program at the Regional Office level. More specifically he assists Forest personnel with spray area delineation, spray block boundary determinations, and the training of unit biologists, insect development checkers, spray deposit checkers, and post mortality checkers.

In order to avoid delays in the control program, the assistant project director will act for the director when the latter is not available for counsel.

3. Contracting Officer

The regional contracting officer will be responsible for all bid solicitations and awarding of contracts for spray plane services, insecticide, all qualifications, specifications and heavy construction and/or equipment. He will designate the unit supervisor as his representative in obtaining contractual compliance. Interpretation of contracts and controversial disputes with contractor's representatives that cannot be resolved at the local project officer's level will be referred to the regional contracting officer.

4. Formulation Checker

A formulation checker will be assigned to the project by the regional contracting officer. He will check all insecticide testing and gallonage measurements for contract compliance for payment purposes. He is responsible to the contracting officer.

5. Air Officer

The regional air officer will be responsible for developing specific guidelines and for exerting leadership in aerial safety practices. More specifically, his duties will be:

a. To contact the Federal Aviation Agency and determine adequacy of airfields to be used.

(1) Length and width required for type airplane to be used.

(2) Amount of maintenance and surfacing needed.

(3) Altitude and spray load capacity allowed.

(4) Check present flight pattern, or develop one.

b. Advise project director on the type aircraft that will do the best and safest spray job.

(1) Help write specifications to exclude unsafe airplanes.

(2) Prevent four-engine planes from spraying in mountainous country.

c. Inspect contractor's aircraft for compliance with contractual requirements prior to and after contract is awarded.

(1) A special trip to the contractor's hangar will be necessary to obtain needed personnel and aircraft information (Form 22-5730-1, Exhibit 4-A). Spray systems will be checked and proposed changes discussed on the same visit.

(2) Final inspection is made when plane arrives at Missoula Airport for calibration tests. All aerial safety requirements as included in the contract specifications, State, and Federal Aviation Agency regulations will be checked. State spray licenses must be valid for the current season.

d. Calibrates spray apparatus to determine flow rate (gallons per minute), atomization (mean median diameter), and effective swath width (Form 22-5700-8, Exhibit 4-B).

e. Determine that spray systems are clean, sound, and free of leaks.

f. Following the initial calibration at the beginning of the project, makes subsequent checks when aerial observers report improper rate of discharge or when spray deposit checkers report improper deposit and atomization.

g. Train aerial observers in maintaining proper height above spray planes.

FOREST RESPONSIBILITY

The Forest will be responsible for the development of the project's operational and safety plan that will include the organization and the recruitment of personnel for key positions under the project supervisor (Exhibit 5).

Budget Estimate

After a Forest organization has been developed and their operating plan completed, the Forest will assist in developing the initial budget estimate for the spray project. Upon review and approval by the project director, the Forest will be given funds to cover all approved expenditures for force account labor and contract work, such as, insecticide purchases, plane services, airport construction and maintenance, survey personnel, transportation, administrative help, etc., (Form 25-5240-1, Exhibit 6). Revised operating plans must be approved by the project director.

Cooperative control funds collected from private landowners will be utilized on the project as soon as the funds are obtained from the State.

1. Project Supervisor

Project supervisor will be responsible for and fully authorized to conduct all general administrative phases of the suppression program to which assigned. After carefully studying the insecticide and spraying contracts, he will be

given full authority for making all necessary on-the-ground decisions. These are vital to the successful prosecution of an emergency program such as the budworm spray project. A project supervisor will maintain communication and liaison with the project director each day when spray operations are underway. A most important and integral part of the project supervisor's responsibility is the safety and welfare of all personnel and equipment assigned to the project, including that of contractors. See that all specifications and qualifications of all contract items are carried out. Specifically, the duties of a project supervisor are:

a. Direct the activities of the field personnel assigned to his unit; write brief work or duty responsibilities for such personnel.

b. Make daily reports of spraying operations to project director and Forest Supervisor concerned on form R1-5240-6 (Exhibit 7).

c. Direct the operation at the airstrip. Act as contracting officer's designated representative in ordering insecticide on form R1-5240-5 (Exhibit 8).

d. Alert pilots on hazardous areas, restricted areas, and waters to be avoided in spraying (fish hatcheries, ponds, lakes, and wide-running streams).

e. Observe air and ground safety measures, and take necessary action to remove hazards and prevent accidents. Assign aircraft inspector to following duties:

(1) Check the line inspection, maintenance, and servicing of aircraft reports.

(2) Check for nozzle and emergency trip valve leaks.

(3) Correct any mismanagement of traffic on the airstrip.

f. At the end of each day's spraying, assure himself that all pilots are briefed on sufficient areas for the next day's spraying, so that the pilot will not have to break into the spraying period the next day to become familiar with the new spray block.

g. During the actual spraying, the project supervisor will periodically watch the spray patterns of aircraft.

h. Work closely with the biologists assigned to the unit, and correlate spraying operations with entomological development (Exhibit 9).

i. Determine when weather or other conditions are unsafe or unsatisfactory for spraying. Make a decision to close the operation for the day if wind velocity is over 5 miles per hour or the temperature is over 68° F.

j. Contact contractor's representative to ground spray planes that are not functioning properly. Leaky nozzles will not be permitted.

k. Keep a close check on planes to prevent overloading with insecticide when maximums have been established.

l. Take positive steps to see that the lands of each private cooperator are well sprayed. The failure to do this has been the cause for many complaints in the past.

m. The aerial observer, or project supervisor, will immediately report to the officer-in-charge at the airfield any unusual conditions such as:

(1) Any plane spraying in a block to which it has not been assigned.

(2) Adverse weather conditions aloft that prevent effective spray patterns, with recommendation that spraying be stopped.

(3) Any plane that is not properly performing its assignment.

(4) Any violations of correct and safe flying procedures.

n. Be sure aerial observer takes adequate notes on spraying observations--block, date, time, weather, height of spray plane above topography, pilot, etc. (Exhibit 10)

o. Keep spray progress mosaic up to date. Areas sprayed will be entered daily on mosaic and block progress record.

p. Upon completion of the project, prepare the final report of control operations for the unit. The project supervisor will be responsible for preparing and submitting a narrative report to the Regional Office by September 25. The final report, including the financial statement, will be submitted by October 15.

2. Assistant Project Supervisor

The principal purpose of the assistant project supervisor is to divide the workload of the project supervisor so as to avoid fatigue, both mental and physical, during the active spray program. The assistant project supervisor on each control unit will be directly responsible to the project supervisor for carrying out the duties and responsibilities assigned to him during his scheduled tour of duty. The spray project organization chart and responsibility assignment plan should clearly define the division of duties between the project supervisor and his assistant. Ordinarily, aerial inspection of spraying operations will be assigned entirely to one or the other of the two positions.

3. Unit Biologist

Unit biologists are a part of the regular project organization and as such are administratively responsible to the project supervisor. With guidance of the assistant project director, unit biologists will train and supervise the insect development checkers, the spray deposit checkers, and the pre- and post spray mortality checkers. Using data collected from established development plots, the unit biologist will determine the proper time to apply insecticide to spray blocks and report this information to the project supervisor. They will work in close collaboration with the project supervisor as technical and entomological advisors.

a. Unit biologists will attend a regional 2-day training school. After the school, each biologist should report to the project supervisor of his respective unit.

b. In preparing for the arrival of the development checkers, the following jobs should be accomplished:

(1) Become familiar with the boundaries of the unit and the spray blocks.

(2) Select a number of accessible locations scattered throughout the unit to be used as larval development plots. These plots should be selected so as to sample:

(a) A wide range of elevations (within 500-foot elevational zones).

(b) Typical infested Douglas-fir timber types.

(c) North and south exposures.

(d) Ridges and drainage bottoms.

(e) Foliage that can be reached from the ground.

(3) Tag the center of all selected plots with a "Budworm Development Plot" tag. Indicate plot number on tag.

(4) Fill in all the information requested on the tag, including the elevation as determined with an altimeter or from a contour map.

(5) Fill out form R1-5240-3, Spruce Budworm Development Plot Data, in triplicate, for each plot. Two copies will be kept by the unit biologist, the other copy will be given to the checker (Exhibit 11).

(6) Arrange the plots into twice as many groups of 4 to 6 plots each as there are budworm development checkers assigned to the unit, keeping in mind:

(a) Time required to travel to plots from unit headquarters.

(b) Ease with which larvae may be collected.

(c) Distance between plots.

(d) Capability of checker assigned to plot.

(7) Locate and number each plot accurately on a unit map.

c. After the collections of larvae have begun, the unit biologist will supervise the collections and instar determinations of the larvae. From the larval developmental records, the unit biologist will make decisions as to when spraying will start by using the following guides:

(1) Upon receipt of forms R1-5240-2, Larval Development Record, he will enter the data from all plots on the development chart (Exhibit 12).

(2) When 20 percent of the larvae on 2 or more spray blocks in the unit have entered into the fourth instar, the project supervisor will be notified so that he can advise the Regional Office (contract officer) that spraying operations can start in the unit in approximately 10 days.

(3) When 60 percent or more of the larvae enter into the fifth and sixth instars and there are less than 3 percent third instar larvae in a spray block, the unit biologist will notify the project supervisor that the spray block is released for spraying (Exhibit 13).

(4) As 60 percent of the developing larvae in additional spray blocks enter the fifth and sixth instars (with less than 3 percent third instars), the unit biologist will notify the project supervisor.

(5) When larval collections in any block show that 5 percent or more of the population has entered the pupal stage before spraying, the project supervisor should be immediately notified so spraying on that block can be stopped.

d. The unit biologist will keep the progress chart up to date--form R1-5240-4 (Exhibit 9).

e. A graphic development chart will be kept current.

4. Development Checkers

Budworm development checkers will be trained by the unit biologist on the spray units to which they are assigned. Each checker will be given:

a. A definite assigned number of collection plots.

b. Directions for reaching these plots (Form R1-5240-3).

c. Guidelines for taking samples and recording data are:

(1) Mark the location and number of each plot on his personal unit map.

(2) Become familiar with the location of each plot.

(3) Decide on the order of sampling the plots in each daily group and follow this order each collecting day.

(4) Sample each group of plots on alternate days.

(5) Upon arrival at the plot, label the collecting vial.

(6) Collect budworm larvae from infested trees as follows:

(a) Collect larvae within a radius of 100 yards of the plot center.

(b) Cut a 15-inch twig from an infested tree.

(c) Open all foliage buds and collect any larvae within (early collections).

(d) Collect all larvae and pupae on the twig (later collections).

(e) Place all larvae and pupae collected in the vial and float them in collection solution.

(f) When all larvae on the twig have been collected, move to another tree and cut another twig.

(g) Repeat this procedure until the required number of larvae are obtained.

(h) Additional twigs cut will be chosen at random and each should be from a separate infested tree.

(i) Collect all larvae on each twig cut; do not stop collecting in the middle of a twig.

(7) Twenty-five larvae will be collected from each plot each collection date from the time collections are started until 10 days prior to the beginning of spraying.

(8) Fifty larvae will be collected from each plot during the 10-day period preceding spraying and during the spraying operations. If the spruce budworm population is low, collect only 25 larvae.

(9) If the daily collections are completed before 1 p.m., scout the area and make observations and notes on the percentages of open buds, returning to project headquarters by 4 p.m.

(10) Between 4 and 5 p.m. on the day larval collections are made, the checker will examine the larvae collected at unit headquarters. This will be done under the supervision of the unit biologist, as follows:

(a) Place the larvae, from one plot at a time, in a petri dish, and then separate them in watch glasses according to their instar classification.

(b) Determine the proper instar by comparing the collected larvae with a set of sample larvae classified as to instar.

(c) Count the larvae and determine the percentage in each instar. (Use the Rowland percentage chart.)

(11) Record these counts and percentages on form R1-5240-2, Spruce Budworm Development Checker's Daily Report, and give this report to the unit biologist before 6 p.m. each day.

(12) Return all spruce budworm larvae to the original collecting vials after counting and store these vials at unit headquarters.

(13) Place other defoliating larvae in a separate labeled vial.

5. Spray Deposit Checkers

Some spray deposit checkers may be recruited from the budworm checkers, as blocks are sprayed development plots are eliminated.

After a spray block has been released for spraying, and within 1 to 2 days before spraying commences on the block, the unit biologist will designate on the progress chart the date and checker for putting out the spray deposit cards.

a. The spray deposit checker will then locate the start of the line on the photo mosaic and will receive directions from the unit biologist on how to reach the starting point.

b. On the date stated on the Unit Progress Chart (R1-5240-4), the checker will travel to the start of the line, where spray deposit cards will be distributed in the following manner.

(1) Attach location string to the starting tag.

(2) While trailing the string, pace along the line on the bearing designated.

(3) Place a spray deposit card on the ground at each 4-chain interval along the line.

(4) Select card locations in forest openings. If possible, place card 50 feet from nearest tree. If an opening cannot be found and card is placed under overhead foliage, indicate as such on back of card.

(5) Secure card to ground with large paper clip and nail.

(6) Place serial numbered side of card face down.

(7) Adjust paper clip to prevent curling of card.

(8) Secure location string to the nail in each card so they can be located easily by the pickup checker.

(9) Keep a record of the serial numbers on the cards and their order on the line.

c. Upon returning to headquarters, date the "Spray deposit cards put out" (Column 10) on the Unit Progress Chart and indicate the serial numbers of the cards used in the block.

After the spraying of the block has been completed and the project supervisor has so indicated by dating and signing the "Spraying in block completed" (Column 12) of the Unit Progress Chart, the spray deposit line will be rerun in the following manner:

a. In the "Spray deposit cards to be picked up" (Column 14) of the Unit Progress Chart, the unit biologist will indicate which checker will rerun the line and the date on which it will be done.

b. The checker will proceed to the line location tag and follow the string, retrieving the cards in order.

c. As each card is collected, it will be given a brief examination for spray deposit spots.

d. If there are no oil deposit spots, or only a few, the checker will make a further and immediate examination, within a 50-foot radius of the card, as follows:

(1) Make a check of foliage for evidence of oil burning.

(2) Check for death webs on infested fir trees.

(3) Look for dead or dying larvae on trees or ground.

(4) Make notes of the above checks on the back of the spray card.

(5) Collect a few leaves of wild rose, strawberry, or other sprayed shrubs and tape them on the back of the card.

(6) Indicate amount of screening by foliage (distance of spray card from tree).

e. After the spray deposit cards have been collected, they should be returned to unit headquarters and given to the unit biologist.

f. In the "Spray deposit cards picked up" (Column 15) of the Unit Progress Chart, place the date the cards were collected on the appropriate line.

Post mortality checking will fall into two categories: (1) immediate effect on the aerial spray job, expressed in percent of kill, and (2) September residual population counts of egg masses from sample trees.

Percentage of kill 10 days after spraying. To determine the effectiveness of the aerial spraying, it will be necessary to take a sampling of the larval population in control units, immediately prior to and 10 days after the spraying in selected blocks. Comparison of the living larval population before and after spraying will provide a fairly accurate estimate of the percentage of mortality occurring in an area.

6. Mortality Checkers (recruited from development checkers and spray card checkers).

Control project personnel will determine the budworm mortality as accurately as possible by following this procedure:

a. One or 2 days before a block is to be sprayed, a mortality line will be established perpendicular to the swath width for each block.

b. Mortality lines will be run in conjunction with spray card lines where practicable to do so.

c. A mortality line will consist of 10 sampling stations. Each station will be 4 chains (264 feet) apart. Each station will be marked by tagging the trees from which the samples will be taken. The first collection at each sampling station will require the cutting of 1 branch (15 inches long) from each of 2 trees (2 branches). These branches will be clipped over a collecting cloth. The branches and all the larvae from these branches will be placed in plastic bags or zippered pillow cases and returned to the unit headquarters. Careful collecting is a must.

d. In the laboratory, the branches and the inside of the bags will be carefully examined for all larvae and pupae. After these larvae and pupae are collected, they will be placed in vials. Be sure that every bud is opened and examined carefully.

e. After classifying the larvae to its developmental stage (instar), all larvae, pupae, or current year's pupal cases are to be preserved in alcohol solution.

f. All vials will be carefully marked with a spray block number, mortality line number, larval instars present, and date of collection.

g. In large blocks, two or more lines will be desirable. This decision will be left to the project supervisor.

h. If a mortality line is established and the block is not sprayed within 5 days, the lines will be reestablished.

i. Ten days after the stands around the mortality line have been sprayed, these lines will be rerun and collections made from the 2 trees at each station. However, at each sampling station 2 branches (15 inches long) from each of 2 trees will be clipped over a collecting cloth.

j. The larvae and/or pupae from these branches will be collected and placed in collecting vials.

k. All unit supervisors will be notified of the resultant mortality as soon as it can be calculated by the formula:

$$\left(\frac{\text{Prespray sample} \times 2 - \text{Post spray sample}}{\text{Prespray sample} \times 2}\right) 100 = \text{Percent Mortality}$$

The residual population will be obtained by resampling trees from which the egg masses were collected the preceding year. (See Biological Evaluation No. 2.)

7. Aerial Observer

Aerial observations are usually made by the assistant project supervisor and aerial observers. They are directly responsible to the project supervisor. They will stay aloft while spray planes are in the air and report on each spray load observed (Exhibit 10). A 12- by 12-inch lap board (having the spray block mosaic on one side and a one-half inch map on the other) should be used to sketch in spray coverage. More specifically, his duties include:

a. Keeping spray plane in assigned spray block.

b. Reporting leaking spray nozzles. These are best seen during the turns of the plane at the end of each swath or on ferry trips to and from the spray area.

c. Check on application of spray. The spray ribbon should settle into the trees without appreciable side drift within 5 minutes after passage of the spray plane. Excessive side drift or vertical boiling of the spray will require termination of the spraying.

d. Take air temperature at spray plane altitude after spray plane has left area. These readings should start at about 8 a.m. The observation plane should remain above and behind the spray plane and cross the spray swath frequently for effective observation.

e. Determine the height of spray plane above the trees. Accurate determinations are difficult. A rough estimate can be made by using

multiples of tree heights as a basic measurement. The observation plane should never fly at the same altitude as the spray plane to estimate the height of the spray plane.

f. Observe for potential flight hazards (power lines, etc.) and safe flying practices. Immediately report forced landings.

8. Project Communications Chief

The duties of this position are somewhat limited but exceedingly important. The principal responsibility of the communications chief is to see that the going spray project is in constant communication where and when needed. In some instances other duties may be assigned to this position, such as:

a. Planning the location and placing the weathermen in spray blocks.

b. Keeping all weather records and reporting unfavorable temperatures or wind velocities to the project supervisor (Form R1-5240-11).

c. Training the weathermen to take:

(1) Temperatures in partial shade (thermometers to be located in partial shade).

(2) Moisture records (spraying will not start if water can be shaken from foliage or rain is predicted within 4 hours).

(3) Average wind velocities in exposed locations. (Wind is recorded as from the direction it comes from.)

9. Project Administrative Assistant

This position carries with it the Forest's responsibility for maintaining all the essential reports, progress maps, and records required by the control operation. The project administrative assistant serves as office manager and accountant for the project supervisor.

Some of the more important items are:

a. Daily log record of overall activities including record of written messages and telephone and radio calls of importance (Form 5100-4 with tickler list 5240-15, Exhibit 14).

b. Daily records of airfield operations on the following forms. Sample forms in Exhibit 15:

(1) Daily Budworm Project Safety Inspection Record, R1-5240-9.

(2) Daily Aircraft Certification Report, R1-5240-10 (Checked by aircraft inspector).

(3) Spray Period Weather Report, R1-5240-11.

(4) Individual Daily Spray Plane Record, R1-5240-12.

(5) Record of Insecticide Sprayed on Individual Blocks, R1-5240-13.

(6) Record of Observation Plane Flights, R1-5240-15 (in triplicate).

c. Insecticide Inventory Record, R1-5240-14, in triplicate by 4 a.m. daily (Exhibit 16).

d. Spraying progress map on builtup mosaic.

e. Other normal payroll and accounting records pertinent to the project.

APPENDIX

Exhibit Note: SBW Development Chart or the instructions are not included in this.

1. Acreage Tabulation, R1-5240-7.

2. Forest Insect Control Agreement, 25-3450-1. (made in quadruplicate)

3. Regional Organization Chart.

4. Air Officer Inspection Records.

   A. Spray System Inspection, 22-5730-1.

   B. Equipment Checklist, 22-5700-8.

5. Unit Organization Chart.

6. Chart Operating Plan, 25-5240-1. (Chart 2 feet by 2 feet)

7. Spruce Budworm Daily Spray Coverage Report, R1-5240-6.

8. Insecticide Inventory Notice, R1-5240-5.

9. Chart Spruce Budworm Control Project - Unit Progress Report Chart, R1-5240-4. (This is filled each time a plane takes off)

10. Spruce Budworm Control Aerial Observation Report, R1-5240-8.

11. Spruce Budworm Development Plot Data, R1-5240-3.

12. Larval Development Record, R1-5240-2.

13. Notice of Spray Block Release, R1-5240-17. (In Triplicate)

14. Tickler List for Use with Form 5100-4, R1-5240-16. - This is simply a guide - give one to each

15. Daily Records for Airfield.

   A. Daily Budworm Project Safety Inspection Record, R1-5240-9.

   B. Daily Aircraft Certification Report, R1-5240-10.

   C. Spray Period Weather Report Record, R1-5240-11.

   D. Individual Daily Spray Plane Record, R1-5240-12.

   E. Record of Insecticide Sprayed on Individual Blocks, R1-5240-13.

   F. Block Progress Record. (In quadruplicate for each block)

   G. Record of Observation Plane Flights, R1-5240-15. (In triplicate)

16. Insecticide Inventory Record, R1-5240-14. - (In triplicate)

ACREAGE TABULATION
(Reference FSM 5242.12)

Control unit

Spray block

Compiled by

Date

Location			Ownership acreages					Total spray (acres)	Remarks
Township	Range	Section	NF	BLM	S	LP	SP		

Exhibit 1

25-3450-1 (Revised 4/64)

FOREST INSECT CONTROL AGREEMENT
(Reference FSM 3404.6)

This agreement, made on the _____ day of _____, 19____, by and between _____, _____,
Name Mailing address
hereinafter called the Cooperator, and the State Forester of the State of Montana, and through him with the United States Department of Agriculture, Forest Service, hereinafter referred to as the Forest Service,

WITNESSETH:

WHEREAS, the Cooperator owns certain forest lands situated in the forest insect control area designated and described as _____ unit and legally described as follows:

Section Township Range

and, containing _____ acres of forested spray area, and,

WHEREAS, certain timber on said forest lands and other forest lands in State and other public ownership intermingled or adjacent to Cooperator forest lands are now being attacked by spruce budworm and control of this insect is essential to protect the timber stands and prevent further spread of the infestation and the cooperative efforts of all forest owners is essential to assure control, and,

WHEREAS, the State of Montana and the Forest Service have joined in a program to control the infestation during the calendar year _____ in accordance with the provision of the Forest Pest Control Act of June 25, 1947 (61 Stat. 177; 16 U.S.C. 594-1 to 594-5), and the provisions of Chapter 25 - Montana Session Laws 1953 (Secs. 28-130 to 28-134, R.C.M. 1947).

NOW, THEREFORE, it is mutually agreed by and between the parties hereto, as follows:

1. The Forest Service under agreement with the State Forester and through him with the Cooperator subject to the provisions hereof, will attempt to control the insect infestation on said lands.

2. The Cooperator will pay the State Forester (or the Forest Service) upon presentation of a bill of collection $_____ as his contribution toward the cost of control work to be expended by the Forest Service in conducting the work. The funds so collected by the State Forester or the Forest Service will be deposited in the Cooperative Work Fund of the United States Forest Service or to the credit of appropriations expended for such control.

3. Any sums of money deposited by the Cooperator under this agreement not expended under the provision thereof, shall upon termination of this agreement be refunded to the Cooperator by the State Forester or the Forest Service.

4. The Forest Service and the State of Montana shall not be liable for any damages incident to cooperation under the terms of this agreement.

5. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this agreement or to any benefit to arise therefrom. Nothing, however, herein contained shall be construed to extend to any incorporated company if the agreement be for the general benefit of such corporation or company.

6. This agreement shall be in force from the date of January 1, 19___, to December 31, 19___, both dates inclusive or until the cooperative work on said lands is completed, unless otherwise terminated in a manner agreed upon between the State Forester and the Forest Service.

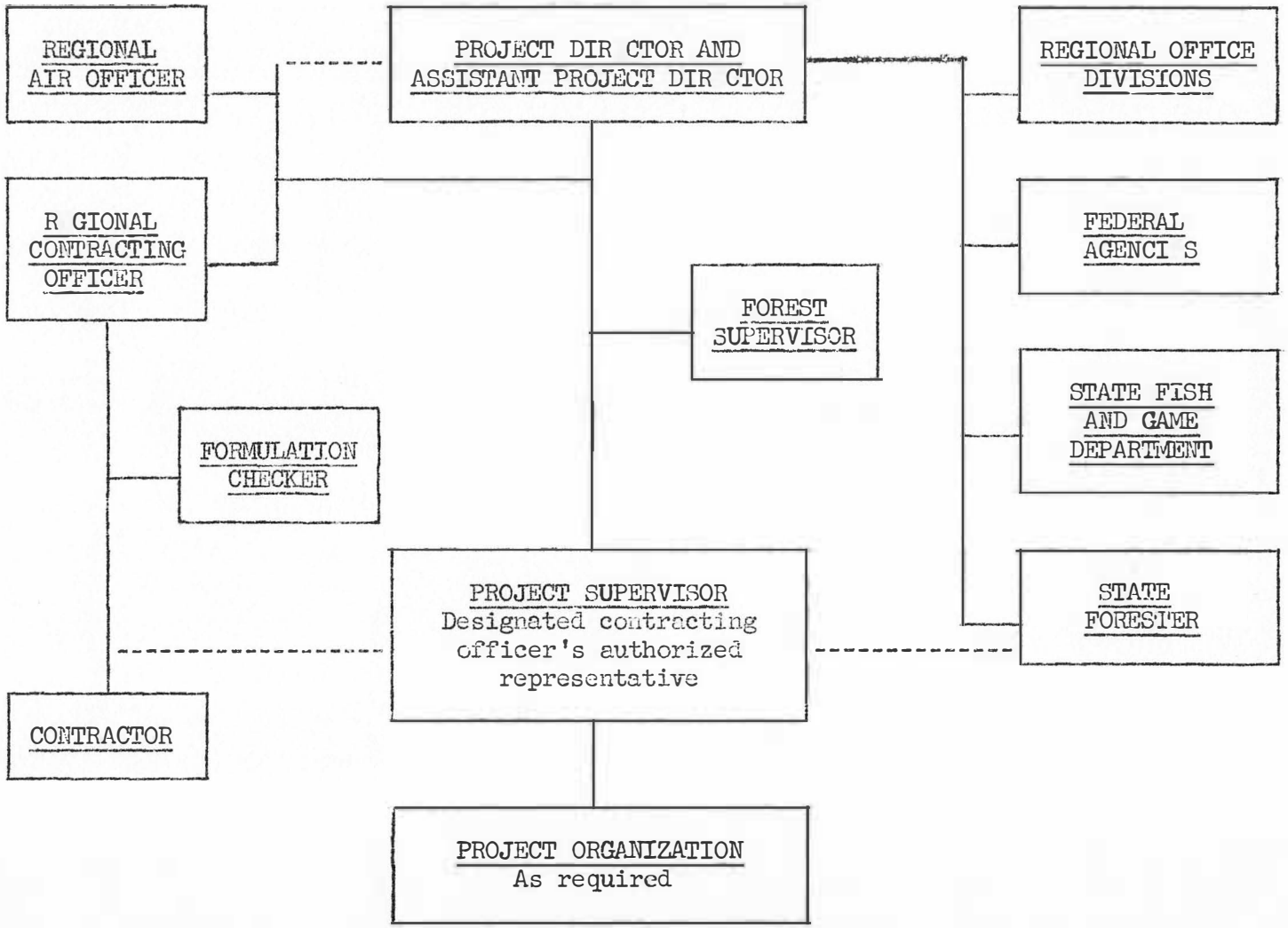
IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed as of the date hereinabove written.

_____, 19___ _____
Date Cooperator

_____, 19___ _____
Date State Forester or his Authorized Representative

Exhibit 3

R GIONAL ORGANIZATION CHART



SPRAY SYSTEM INSPECTION

Inspected by: ..... Location: ..... Date: .....

AIRPLANE:

1. Make and model: ..... Reg. No.: .....

2. Contractor: ..... Owner: ..... Pilot: .....

SPRAY SYSTEM:

1. Tank: exterior filler? ..... green: ..... marked spray? .....

   size opening ($2\frac{1}{2}$" min.) ..... capacity ..... gals.

   vent size ..... vent area ..... sq. in.

2. Dump valve: size ..... area ..... sq. in.

   $\frac{\text{Load in gals.}}{\text{Area in sq. in.}}$ = ... min. single engine 7.65
   multi-engine 9.6

   control to cockpit? ..... close only on ground? ..... linkage okay? .....

3. Pump: type and size ..... pressure ..... psi

   how driven? ..... brake (if wind drive) .....

4. Boom: length (min. 1/2 wind span) ..... diam. .....

5. Nozzles: number ..... make and size .....

   orifice direction? ..... positive shut-off? .....

6. General: system leak proof? ..... other .....

CALIBRATION:	1	2	3	4	5	6
Load in gals.						
Spray time, min.						
Gal. per min.						

ATOMIZATION: D_{max} (Five largest drops) .....

mmd .....

RECOMMENDED SWATH ..... ft.

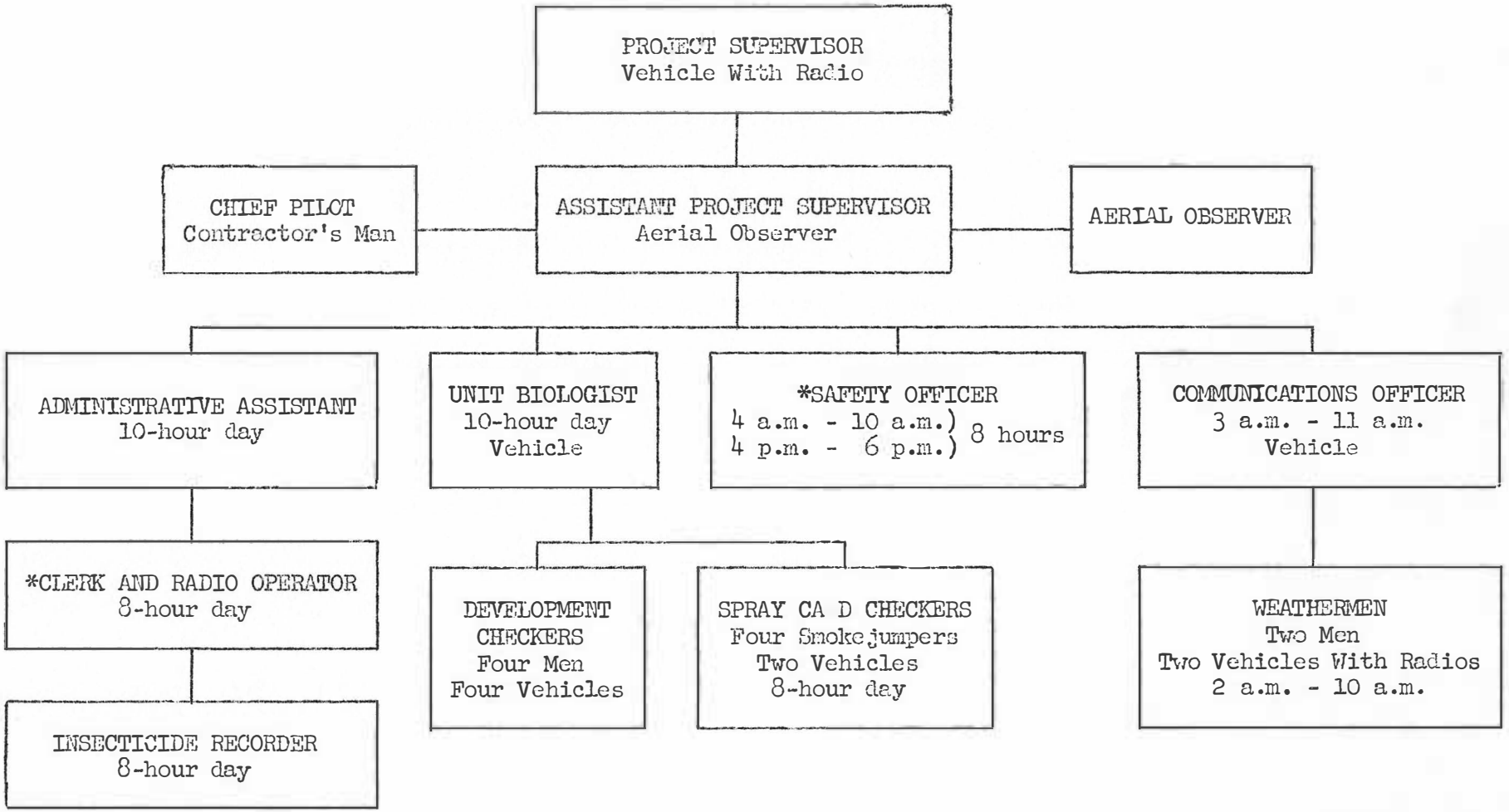
AIRCRAFT EQUIPMENT CHECKLIST

C O N T R A C T O R	AIRPLANE	NUMBER

1. Bar or strap across doorway	
2. Bench (seat), folding	
3. Cable, cargo droppers	
4. Cable, smokejumpers static line	
5. Fire extinguisher	
6. Flashlight	
7. Handrail, cargo droppers	
8. Instruments, blind flight group	
9. Intercom, pilot to spotter	
10. Kit, first aid	
11. Light, anti-collision, rotating	
12. Radio, Forest Service	
13. Radio, 2-way, FAA frequencies	
14. Shoulder harness	
15. Signal device, electric, cargo drop	
16. Signal device, electric, spotter	
17. Step, jump	
18. Tiedowns, cargo	
19. Window, spotting	
20. Seats, passenger, reclining	

Exhibit 5

UNIT ORGANIZATION CHART



*May be same man

25-5240-1

FOREST INSECT AND DISEAS CONTROL
OPERATING PLAN

CONTROL UNIT _____

FOREST _____

Original Operating Plan F.Y. _____
Revised Operating Plan No. ___ F.Y. _____
Appropriation _____

FISCAL YEAR 19 ____

FISCAL YEAR 19 ____

CONTRACTS:			Dollars			Dollars
Spraying	_____	Acres	_____			
Insecticide	_____	Gallons	_____			
Insecticide	_____	Gallons	_____			
Observation Plane	_____	Hours	_____	_____	Hours	_____
Respray Contingent	_____	Acres	_____	_____	Acres	_____

Position and Name	Number pay periods	Pay period rate	Base operating plan	Overtime	Per diem	Total operating plan	Revision requested + or -	N mber pay periods	Pay period rate	Base operating plan	Overtime	Per diem	Total operating plan	Revision requested + or -	Remarks
PRE-CONTROL:															
Unit Biologist _____ GS															
Survey Crew _____ No. GS															
_____ No. GS															
Mileage _____															
CONTROL:															
Unit Supervisor _____ GS															
Communication Tech. No. GS															
Transp. Coordinator No. GS															
Indirect Gen. Exp.(909) _____															
Asst. Unit Supervisor _____ GS															
Unit Biologist _____ GS															
Asst. Unit Biologist _____ GS															
Admin. Assistant _____ GS															
Devel.Checkers _____ No. GS															
_____ No. GS															
Spray Card Checkers No. GS															
No. GS															
Insecticide Checkers No. GS															
No. GS															
Radio/Tel. Operator No. GS															
Aerial Observer No. GS															
Airport Mtce. Men No. GS															
No. Rate															
Weathermen _____ No. GS															
No. GS															
Mileage (FS) _____ No. Rate															
Contractual Equip.-Rental Rate _____															
Mileage Rate _____															
Communications _____															
Rents & Utilities _____															
Equipment & Supply _____															
Airport Construction _____															
Airport Mtce. _____															
POST-CONTROL:															
Unit Biologist _____ GS															
Mortality Checkers No. GS															
No. GS															
Insect Counters No. GS															
No. Rate															
Mileage _____															
TOTALS															

Exhibit 6

R1-5240-6 (Revised 3/64)

SPRUCE BUDWORM DAILY SPRAY COVERAGE REPORT
(Reference FSM 5242.13)

(To be mailed to Regional Office, Division of State & Private Forestry, daily, immediately following morning spraying operations.)

Unit ..... Date .....

a. Total acreage (gallons) sprayed today .....

b. Cumulative total acreage sprayed to date .....

c. Number of spray planes operated today .....

d. Average length of spray period today (show to nearest tenth hour) .....

e. Remarks (reasons for low output, plane troubles, weather, etc.)

f. Total acreage formally approved to date by unit biologist and unit supervisor as being satisfactorily sprayed .....

g. Total gallons of insecticide metered into spray planes to date (cumulative total) .....

.....
Reporting Officer

(Instructions on reverse)

Exhibit 7

Instructions

Item a. Show total metered gallons of insecticide sprayed in unsprayed area. Do not include the gallonage of respray, dumped, loads or heavy losses due to spillage.

Item b. Use actual block acreages as each block is completed. Estimate partial blocks sprayed prior to current date. Totals reported under item a will not add up to cumulative total shown under item b. Item a is merely a daily output estimate based on gallons of spray output. Item b becomes a firm cumulative spray acreage total based on actual block acreages.

Item g. Include spray loads, respray loads, dumped loads, and all insecticide metered into spray planes.

R1-5240-5 (Revised 4/64)

INSECTICIDE INVENTORY NOTICE[1/]

(Reference FSM 5242.21)

19..... ..... Control Unit

TO: .....

Contractor's Representative

....., Montana

Date .....

Hour .....

Insecticide in tanks ..... gallons

Pursuant to Section ....., paragraph ....., Contract No. .....,
you shall have available ..... gallons of insecticide by
4:00 a.m., ... to fulfill the minimum gallonage
(Date)
required.

Failure to have this amount of insecticide available will result in liquidated damages accruing to the Government, if the spraying operation be delayed by reason of the quantity of insecticide ordered not being available.

.....
Contracting Officer's Designated Representative

Received .... Request fulfilled ....
(Date) (Time) (Date) (Time)

By ..... By .....
Authorized representative of

.....

[1/] Notice will need to be served on the contractor at least 12 hours in advance of the effective 4:00 a.m. date.

Exhibit 9

SPRUCE BUDWORM CONTROL PROJECT

R1-5240-4

UNIT -

UNIT PROGRESS CHART

REFERENCE FSM 5242.14

19

1	2	3	4	5		6		7		8		9		10		11		12		13	14		15		16	17			18		19		20						21	22	23	24
SPRAY BLOCK NUMBER	BLOCK NAME	ACRES IN BLOCK	GALLONS OF INSECTICIDE USED	RELEASED FOR SPRAYING		PRESPRAY POPULATION CHECK ASSIGNMENT		PRESPRAY POPULATION CHECK COMPLETED		DATE BLOCK TO BE SPRAYED		PUT OUT SPRAY DEPOSIT CARDS ASSIGNMENT		SPRAY DEPOSIT CARDS PUT OUT		NUMBERS OF SPRAY CARDS USED IN BLOCK		SPRAYING IN BLOCK COMPLETED		SPRAY PLANES USED IN BLOCK	SPRAY DEPOSIT CARD TO BE PICKED UP		SPRAY DEPOSIT CARDS PICKED UP		AVERAGE SPRAY DEPOSITED PER ACRE	APPROVAL OF SPRAYING			POSTSPRAY POPULATION CHECK ASSIGNMENT		POSTSPRAY POPULATION CHECK COMPLETED		SPRUCE BUDWORM POPULATION COUNTS								PERCENT BUDWORM MORTALITY	SPRAY BLOCK NO.
																										RE-SPRAY	COMPLETED	UNIT SUPERVISOR					PRESPRAY			POSTSPRAY						
				DATE	BIOLOGIST	DATE	CHECKER	DATE	CHECKER	DATE	U. SUPER	DATE	CHECKER	DATE	CHECKER	START	END	DATE	U. SUPER	TYPE	DATE	CHECKER	DATE	CHECKER	POUNDS	DATE	DATE		DATE	CHECKER	DATE	CHECKER	LARVAE	PUPAE	TOTAL	LARVAE	PUPAE	TOTAL				

SPRUCE BUDWORM CONTROL AERIAL OBSERVATION REPORT
(Reference FSM 5242.13)

1. Plane ..... 2. Spray block ..... 3. Time .....

4. Swath width .....

5. Swath location with respect to previous swath .....

6. Spray plane height .....

7. Leaks or plugged nozzles .....

8. Spray action .....

9. Spray pattern near lakes or streams .....

10. Is the spray plane in proper block? .....

11. Number of minutes to deposit spray load .....

12. Air temperature at spray plane altitude .....

Date ..... Observer .....

Remarks:

R1-5240-3 (Revised 3/64)

Block no.

SPRUCE BUDWORM DEVELOPMENT PLOT DATA
(Reference FSM 5242.12)

Collection plot number ..... Elevation .....

Location:

Control unit .....

Spray block no. .....

Spray block name .....

Section ....., Township ....., Range .....

Travel directions .....

.....

.....

.....

.....

.....

.....

.....

.....

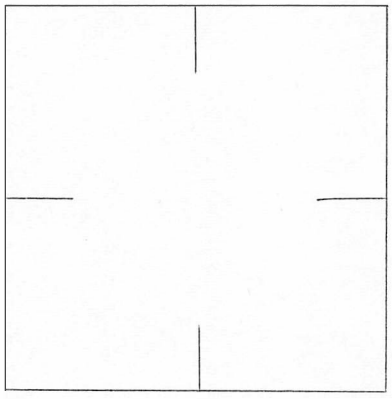
.....

.....

Exposure:
Topography: ridge, creek bed, flat

Stand Description:
Timber type: DF, LPP, WF, S, PP, AF.
Average overstory, d.b.h.: 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 44, 46, 48.
Average understory, d.b.h.: 2, 4, 6, 8, 10, 12, 14, 16, 18.
Density of stand: light, medium, heavy, very heavy.

Map location



Section No. .....

1 copy to development checker
2 copies to unit biologist

Exhibit 11

R1-5240-2 (Revised 3/64)

DAILY SPRUCE BUDWORM LARVAL DEVELOPMENT RECORD

(Reference FSM 5242.12)

Unit .....

Date of collections .....

Station No. and elevation	Larval instars										Pupae		No. larvae collected	Collector
	2d		3d		4th		5th		6th					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Totals														

Approved .....
(Unit Biologist)

1 copy to unit biologist

Exhibit 12

NOTICE OF SPRAY BLOCK RELEASE
(Reference FSM 5242.12)

Spruce Budworm Control Project

Spruce budworm larval populations will be ready for spraying on the following blocks in the ..... Control unit on ....., ...
(Day) (Date)

Block number	Block name
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

APPROVED	Unit biologist	Date

1 cc to: Unit supervisor
Project director

Exhibit 13

TICKLER LIST FOR DAILY LOG AND DIARY BOOK RECORD
(Use dispatcher Daily Log and Diary, form 5100-4)
(Reference FSM 5242.13)

Control unit _____

1. Record notification of spray plane clearance by proper inspectors.

2. Record date of arrival of planes and number of planes arriving at each date and name of pilot for each plane.

3. Record all telephone calls from and to regional project director.

4. Record all decisions made by telephone conversations.

5 Record all telephone conversations made with insecticide or flying contractors.

6. Record important decisions reached in conference on the project between contractor and unit supervisor or regional project director.

7. Record all accidents reported and action taken.

8. Record the date, hour, minute, station, and persons involved in all transactions entered in the logbook.

DAILY SPRUCE BUDWORM PROJECT
SAFETY INSPECTION RECORD
(Reference FSM 5242.12)

Control unit

Inspector

Date

Airport	Satisfactory	Unsatisfactory	Action taken
Wind socks--airport hazards			
Runway condition--traffic light available			
Operational Headquarters			
Supplies--telephone--radio			
Yard cleanliness and sanitation			
Insecticide loading zone			
Gasoline loading zone			
Aircraft repair and parking zone			
Forest Service first-aid equipment on hand			
Fire extinguishers†			
1 15-pound CO^2 at each pumping unit			
1 15-pound CO^2 at each nozzle outlet			
1 15-pound CO^2 at gasoline station			
1 15-pound CO^2 at plane maintenance area			
1 15-pound CO^2 for each three parked planes			
Ambulance equipment			
1 panel truck or pickup			
2 15-pound CO^2 fire extinguishers			
1 stretcher			
2 blankets			
1 10- to 25-man first-aid kit			
1 set wrecking and crash equipment			
Bolt cutters, hacksaw, pry bars			
No smoking signs in place at gasoline zone, insecticide zone, specially designated areas			
Certified A&M aircraft mechanic on duty			
Contractor's representative on duty			
Project Personnel			
Trained in woods safety			
Trained in vehicle use safety--licensed			
Proper first-aid equipment--fieldmen (snake kits)			
Proper clothing for woods travel			
Proper clothing to prevent DDT contact			
Signs of allergy to insecticide			

†Needed only when area or facility occupied or in use.

Instructions: Use form daily to record conditions. Check ✓ as satisfactory, x as unsatisfactory. Use reverse side for remarks and explanations. Be sure to call deficiencies to attention of unit supervisor.

DAILY AIRCRAFT CERTIFICATION REPORT
(Reference FSM 5242.13)

Control unit

Aircraft number

Date

	Pilot	Mechanic
1. Aircraft clean		
2. Propeller (engine)		
3. Fuel strainer (drained and made safe)		
4. Fuel and oil quantity (filler caps secure)		
5. Tires, wheels, brakes		
6. Landing gear, struts (main and tail)		
7. Insecticide tanks (leakproof)		
8. Dump valve control		
9. Spray system (boom pump nozzle)		
10. Windshield clean, clear, and unbroken		
11. Control surface covering--no holes, rips, or tears		
12. Wings--covering and bracing		
13. Magneto oil sump plug removed and replaced		
14. Engine acceptable for use		

Pilot's remarks:

Signed .....
Pilot's signature

Mechanic's remarks:

Aircraft is certified as satisfactory and permitted to fly.

Signed .....
Chief mechanic's signature

Exhibit 15-B

SPRAY PERIOD WEATHER REPORT RECORD
(Reference FSM 5242.13)

Control unit

Observer

Date

Location	Time of day	Air temperature	Wind		Remarks
			Direction	Velocity	

Instructions:
Form to be used daily at all weather stations, portable and stationary, and headquarters stations.
Location: Enter section, township, and range, or stream or ridge; i.e., NE$\frac{1}{4}$ sec. 16, T. 6 N., R. 14 W., M.P.M., or East Fork road, mouth of Jennings Creek.
Time: 0300, 0330, or 3:00 a.m., 3:30 a.m.
Air temperature: 68°
Wind direction: S-SW-NW, etc.
Wind velocity: 1 m/h, 6 m/h, 2 m/h, etc.
Remarks: Wind in gusts, wind steady, last reading taken.

Exhibit 15-C

Control unit

Pilot

Plane number

INDIVIDUAL DAILY SPRAY PLANE RECORD
(Reference FSM 5242.13)

Block designation	Date	Gasoline	Spray boom leaks	Safety belt	Shoulder straps	Crash helmets	Time		Meter reading		Gallons of insecticide	Initials of loader and remarks
							Departure	Return	Beginning	End		

Exhibit 15-D

Instructions: Use separate form for each plane.
Block designation: Block number or letter.
Date: Date spraying accomplished.
Gasoline: Record as 1/4, 1/2, 3/4 F (F = full or tank capacity). Unit supervisor and contractor should agree as to total gallons of gasoline each plane should carry to allow for 30 minutes of flying time in addition to gallonage of gasoline required to deliver the spray load properly. Gasoline must be located to meet this required minimum.
The following items should be marked ✓--satisfactory or x--unsatisfactory: Spray boom leaks, safety belt, shoulder straps, crash helmets. All unsatisfactory items must be brought to satisfactory standard before spray plane leaves the ground.
Gallons of insecticide, or spray gallons: Number gallons placed in aircraft (from meter reading).

RECORD OF INSECTICIDE SPRAYED
ON INDIVIDUAL BLOCKS
(Reference FSM 5242.13)

Control unit

Block number or numbers

Acres to be sprayed

Date	Plane number	Pilot	Gallons sprayed	Gallons resprayed	Cumulative total in block	Remarks

Instructions: Unit supervisor will enter data on this form from individual daily spray deliveries for respective blocks. Indicate amount of respray under "Remarks." Use a separate form for each block or combination of blocks assigned to one spray plane.

Exhibit 15-E